

What is claimed:

1. A rotary object feeder comprising:

- 5 (a) a sun member having a sun axis and being rotatable about a sun axis of rotation;
- (b) a sun drive mechanism for driving said sun member in rotation about said sun axis at a rotational speed of $W1$;
- 10 (c) a planetary member mounted for connection to said sun member, said planetary member having a planetary axis located at a constant distance X from said sun axis, said planetary axis being substantially parallel to said sun axis, said planetary member being rotatable about said planetary axis of rotation and also being mounted for rotation around said sun axis with said sun member;
- 15 (d) a planetary drive mechanism for rotating said planetary member about said planetary axis at a rotational speed of $W3$ which is opposite in direction to $W1$;
- 20 (e) N pick-up members mounted on said planetary member, where N is an integer greater than or equal to 3, said pick-up members having pick-up locations at a common radius from said planetary axis, said pick up members being rotatable with said planetary member about said planetary axis and rotating with said planetary member around said sun axis, each of said pick-up members for picking up, holding and releasing an object at respective pick-up locations, each said pick-up location on said pick-up member being a fixed distance equal to L from said planetary axis;
- 25 said pick-up members being driven about said planetary axis and said sun axis such that said pick-up locations of said pick-up members follow a common cyclical path having M apexes, wherein $M = (N+1)$, and $W3$ is equal in magnitude to $(M/N) \times W1$.

2. A rotary feeder as claimed in claim 1 wherein W1 and W3 are constant during a cycle of said pick-up members through M apexes of said common cyclical path.
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3. A rotary feeder as claimed in claim 1 wherein W1 and W3 vary during a cycle of said pick-up members through M apexes of said common cyclical path.
4. A rotary feeder as claimed in claim 1 wherein said sun member is a sun shaft
10 rotatable about said sun axis that passes through its length.
5. A rotary object feeder as claimed in claim 2 further comprising a housing fixedly mounted to said sun shaft and wherein said planetary member is mounted to said housing, said planetary member being rotatable with said housing around said sun
15 axis when said sun member is rotated about said sun axis.
6. A rotary feeder as claimed in claim 3 wherein said planetary member is a planetary shaft mounted for rotation about said planetary axis on said housing.
- 20 7. A rotary object feeder as claimed in claim 1 wherein the distance $L = N \cdot X$.
8. A rotary object feeder as claimed in claim 2 wherein the distance $L = N \cdot X$.
9. A rotary object feeder as claimed in claim 3 wherein the distance $L = N \cdot X$.
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10. A rotary object feeder as claimed in claim 4 wherein the distance $L = N \cdot X$.
11. A rotary object feeder as claimed in claim 5 wherein the distance $L = N \cdot X$.
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12. A rotary object feeder as claimed in claim 1 wherein $N = 3$.
13. A rotary object feeder as claimed in claim 1 wherein $N = 4$.
- 5 14. A rotary object feeder as claimed in claim 1 wherein $N = 5$.
15. A rotary object feeder as claimed in claim 1 wherein $N = 6$.
16. A rotary object feeder as claimed in claim 7 wherein $N = 3$.
- 10 17. A rotary object feeder as claimed in claim 7 wherein $N = 4$.
18. A rotary object feeder as claimed in claim 7 wherein $N = 5$.
- 15 19. A rotary object feeder as claimed in claim 7 wherein $N = 6$.
20. A rotary object feeder as claimed in claim 7 further comprising an idler shaft mounted to said housing, said idler shaft having and being rotatable about an idler axis spaced from said sun axis and said planetary axis, said idler axis being
- 20 substantially parallel to said sun axis, said idler shaft rotating around said sun axis with said housing and said planetary shaft, said idler shaft having a first idler pulley fixedly attached thereto and rotatable with said idler shaft, and wherein said sun shaft has a first sun pulley fixedly attached thereto and which is rotatable with said sun shaft, said sun pulley being interconnected to said idler shaft such that rotation
- 25 of said housing and said idler shaft about said sun axis, causes said sun pulley to rotate said idler shaft about said idler axis.
21. A rotary object feeder as claimed in claim 20 wherein said idler shaft has a second idler pulley fixedly attached thereto and is rotatable with said idler shaft, said
- 30 planetary shaft also having a planetary pulley fixedly attached thereto and which is rotatable with said planetary shaft about said planetary axis, said planetary pulley

being interconnected to said second idler pulley such that rotation of said idler shaft, causes said second idler pulley to rotate said planetary pulley and said planetary shaft about said planetary axis, thereby rotating said pick-up members about said planetary axis.

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22. A rotary object feeder as claimed in claim 1 wherein said pick-up locations are equally angularly spaced about said planetary axis.

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23. A rotary object feeder as claimed in claim 21 wherein said pick-up locations are equally angularly spaced about said planetary axis.

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24. A rotary object feeder as claimed in claim 1 wherein each of said pick-up members has at least one suction cup for picking up, holding and releasing an object at said respective pick-up location, and further comprising an apparatus for delivering air suction force to each of said at least one suction cup.

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25. A rotary object feeder as claimed in claim 21 wherein each of said pick-up members has at least one suction cup for picking up, holding and releasing an object, at said respective pick-up location, and further comprising an apparatus for delivering an air suction force to each of said at least one suction cup.

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26. A rotary object feeder as claimed in 25 wherein each of said apparatus for delivering an air suction force to each said at least one suction cup comprises a vacuum generator having an inlet supplied with pressurized air and an outlet interconnected through a conduit to said at least one suction cup for generating said air suction force.

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27. A rotary feeder as claimed in claim 26 further comprising a valve stack arrangement, said valve stack having an inlet receiving pressurized air through a valve stack inlet conduit, and said valve stack having a plurality of outlets providing pressurized air to a plurality of valve stack outlet conduits interconnected to each

said vacuum generator of each said pick-up members, said valve stack being operable to independently turn on and off the flow of pressurized air to each of said plurality of outlets.

- 5 28. A rotary feeder as claimed in claim 27 further comprising a programmable logic controller interconnected to said valve stack for controlling the flow of pressurized air to each of said plurality of conduits, whereby the air suction force at each of said suction cups can be turned on and off by said programmable logic controller.
- 10 29. A rotary feeder as claimed in claim 1 further wherein said pick up members are mounted to a pick-up hub fixedly mounted on said planetary member for rotation with said planetary member about said planetary axis and said pick-up hub has a plurality of arm members extending radially from said central hub, each of said arm members having one of said N pick-up members mounted thereon.
- 15 30. A method of feeding an object along at least part of a cyclical path having M apexes, said method comprising:
 - (a) rotating said object about a planetary axis at a rotational speed of $W3$;
 - (b) rotating said planetary axis along with said object about a sun axis substantially parallel to said planetary axis, at a rotational speed of $W1$ in an opposite direction to $W3$ at a constant distance X from said sun axis;
 - 20 (c) picking up and releasing said object along said path, at locations that are a fixed distance equal to L from said planetary axis;

wherein $W3$ is equal in magnitude to $(M/(M-1)) \times W1$, and $M \geq 4$.
- 25 31. A method as claimed in claim 15 wherein the distance $L = (M-1) \times X$.
- 30 32. An apparatus for feeding an object along at least part of a cyclical path having M apexes, said apparatus comprising:

- (a) means for rotating said object about a planetary axis at a rotational speed of W_3 ;
 - (b) means for rotating said planetary axis along with said object about a sun axis substantially parallel to said planetary axis, at a rotational speed of W_1 in an opposite direction to W_3 at a constant distance X from said sun axis;
 - (c) means for picking up and releasing said object along said path, at locations that are a fixed distance equal to L from said planetary axis;
- wherein W_3 is equal in magnitude to $(M/(M-1)) \times W_1$, and $M \geq 4$.

33. An apparatus as claimed in claim 32 wherein the distance $L = (M-1) \times X$.

34. A system for feeding containers into a carton holding receptacle comprising

- i) a conveyor system having a carton holding receptacle for receiving and holding a container;
- ii) a container magazine holding a plurality of containers and having a container release position, at which containers can be retrieved from said container magazine;
- iii) a container feeder for retrieving a container from said container magazine and thereafter releasing said container into said receptacle on said conveyor system, said feeder comprising:
 - (a) a sun member having a sun axis and being rotatable about said sun axis of rotation;
 - (b) a sun drive mechanism for driving said sun member in rotation about said sun axis at a rotational speed of W_1 ;
 - (c) a planetary member mounted for connection to said sun member, said planetary member having a planetary axis located at a constant distance X from said sun axis, said planetary axis being substantially parallel to said sun axis, said planetary member being rotatable about said planetary axis of rotation and also being mounted for rotation around said sun axis with said sun member;

- (d) a planetary drive mechanism for rotating said planetary member about said planetary axis at a rotational speed of $W3$ which is opposite in direction to $W1$;
- (e) N pick-up members mounted on said planetary member, where N is an integer greater than or equal to 3, said pick-up members having pick-up locations at a common radius from said planetary axis, said pick up members being rotatable with said planetary member about said planetary axis and rotating with said planetary member around said sun axis, each of said pick-up members for picking up, holding and releasing a container at respective pick-up locations, each said pick-up location on said pick-up member being a fixed distance equal to L from said planetary axis; said pick-up members being driven about said planetary axis and said sun axis such that said pick-up locations of said pick-up members follow a common cyclical path having M apexes, wherein $M = (N+1)$, and $W3$ is equal in magnitude to $(M/N) \times W1$.
35. A system as claimed in claim 34 wherein said container release position of said magazine is positioned proximate at a first of said M apexes of said cyclical path when one of said pick-up members is at said first apex, such that said pick-up member can retrieve a container from said container magazine; and wherein said receptacle is positioned proximate a second of said M apexes of said cyclical path when said one pick-up member has moved from said first apex to said second apex with a container, such that said one pick-up member can deposit said container in said receptacle.
36. A system as claimed in claim 35 wherein $M = 5$ and wherein said first, third and second apexes are adjacent to each other in series.
37. A system as claimed in claim 36 wherein said second apex is positioned at approximately 6 o'clock.

38. A system as claimed in claim 35 wherein said containers are cartons and wherein
said containers in said container magazine are stored in a flattened configuration,
and wherein said system further comprises a carton opening mechanism positioned
5 proximate a third apex of said path, said third apex being between said first apex
and said second apex, and wherein when said one pick-up member is proximate
said second apex, said carton opening mechanism can at least partially erect said
flattened carton to a configuration ready to be received into said receptacle at said
third apex.